



THE MAXWELL EQUATIONS

by

Anatoly Dnieprov

Translated from the Russian
By LEONID KOLESNIKOV

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Anatoly Dneprov (b. 1919), the author of “The Maxwell Equations”, which he wrote in 1960, is a distinguished physicist who works at an institute of the U.S.S.R. Academy of Sciences. His favourite subject is cybernetics – its amazing achievements to date and its breath-taking potentialities. Scientific authenticity is a salient feature of his writings.



I

It all began on a Saturday evening when tired from my mathematical pursuits I took up the local evening paper and came across this advertisement on the last page:

**Kraftstudt & Company Ltd.
accept orders from
organisations and individuals for
all manner of calculating,
analytical and computing work.
High quality guaranteed. Apply:
12 Weltstrasse**

That was just what I needed. For several weeks I had been sweating over Maxwell equations concerning the behaviour of electromagnetic waves in the heterogeneous medium of a special structure. In the end I had managed by a series of approximations and simplifications to reduce the equations to a form that could be handled by an electronic computer. I already pictured myself travelling up to the capital and begging the administration of the Computer Centre to do the job for me. For begging it would have to be, with the Centre working full capacity on military problems and nobody there giving a damn for a provincial physicist's dabblings in the theory of radio-wave propagation.

And here was a computer centre springing up in a small town like ours and advertising for custom in the local paper!

I took up the receiver to get in immediate touch with the company. It was only then I realised that apart from the address the advertisement gave no particulars. A computer centre not on the telephone! It just didn't make sense. I rang up the editors.

"Sorry, but that was all we received from Kraftstudt," the secretary

told me. "There was no telephone in the ad."

The Kraftstudt and Co. was not in the telephone directory either.

Burning with impatience I waited for the Monday. Whenever I looked up from those neatly penned equations concealing complicated physical processes, my thoughts would turn to Kraftstudt Co. Men of vision, I thought. In our time and age when mankind endeavours to clothe its every idea in mathematical garbs, it would be hard to imagine a more profitable occupation.

Incidentally, who was this Kraftstudt? I had been resident in the town quite a long time but the name rang no bell. As a matter of fact, I did vaguely recollect having heard the name before. But I couldn't remember when or where, no matter how hard I jogged my memory.

Came the Monday. Pocketing the sheet of equations, I started out in search of 12 Weltstrasse. A fine drizzle forced me to take a taxi.

"It's a goodish way off," said the cabby, "beyond the river, next door to the lunatic asylum."

I nodded and off we went.

It took us about forty minutes. We passed through the town gates, went over a bridge, skirted a lake and found ourselves in the country. Early green shoots could be seen here and there in the fields along the unmetalled road, and the car stalled between banks of mud every now and then, its back wheels skidding furiously.

Then roofs appeared, then the red brick walls of the lunatic asylum standing in a little depression and jocularly referred to in town as the Wise Men's Home.

Along the tall brick wall bristling with bits of broken glass ran a clinker lane. After a few turnings the taxi pulled up at an inconspicuous door.

"This is Number Twelve."

I was unpleasantly surprised to find that Kraftstudt Co.'s premises were in the same building as the Wise Men's Home. Surely Herr Kraftstudt hasn't ganged up the loonies to do "all manner of mathematical work" for him, I thought—and smiled.

I pressed the doorbell. I had to wait long, the better part of five minutes. Then the door opened and a pale-faced man with thick tousled hair appeared and blinked in the daylight.

"Yes, sir?" he asked.

"Is this Kraftstudt's mathematical company?" I asked.

"Yes."

"And you advertised in the newspaper?..."

"Yes."

"I have some work for you."

"Please come in."

Telling the driver to wait for me, I bent my head and slipped through the door. It closed and I was plunged in complete darkness.

"Follow me, please. Mind the steps. Now to your left. More steps. Now we go up...."

Holding me by the arm and talking thus, the man dragged me along dark crooked corridors, up and down flights of stairs.

Then a dim yellowish light gleamed overhead, we climbed a steep stone staircase and emerged into a small hall.

The young man hurried behind a partition, pulled up a window open and said:

"I'm at your service."

I had a feeling of having come to the wrong place. The semi-darkness, the underground labyrinth, this windowless hall lighted by a single naked bulb high at the ceiling, all added up to a thoroughly odd impression.

I looked around in confusion.

"I'm at your service," the young man repeated, leaning out of the window.

"Why, yes. So this is the Kraftstudt and Co. computer centre?"

"Yes, it is," he cut in with a trace of impatience, "I told you that before. What is your problem?"

I produced the sheet of equations from my pocket and handed it through the window.

"This is a linear approximation of those equations in their partial derivatives," I began to explain, a little uncertainly. "I want them solved at least numerically, say, right on the border line between two media.... This is a dispersion equation, you see, and the velocity of radio-wave propagation here changes from point to point."

Snatching the sheet from my hand the young man said brusquely:

"It's all clear. When do you want the solution?"

"What do you mean—when?" I said, surprised. "You must tell me

when you can do it."

"Will tomorrow suit you?" he asked, his deep dark eyes now full on me.

"Tomorrow?"

"Yes. About noon...."

"Good Lord! What a computer you've got! Fantastic speed!"

"Tomorrow at twelve you will have your solution, then. The charge will be four hundred marks. Cash."

Without saying another word I handed him the money together with my visiting-card.

On our way back to the entrance the young man asked:

"So you are Professor Rauch?"

"Yes. Why?"

"Well, we always thought you'd come to us sooner or later."

"What made you think so?"

"Who else could place orders with us in this hole?"

His answer sounded fairly convincing.

I barely had time to say good-bye to him before the door was shut on me.

All the way home I thought about that strange computer centre next door to a madhouse. Where and when had I heard the name of Kraftstudt?

2

The next day I waited for the noon mail with mounting impatience. When the bell rang at half past eleven I jumped up and ran to meet the postman. To my surprise I faced a slim pale girl holding an enormous blue envelope in her hand.

"Are you Professor Rauch, please?" she asked.

"Yes."

"Here's a package for you from Kraftstudt's. Please sign here."

There was only one name—mine—on the first page of the ledger that she held out for me. I signed and offered her a coin.

"Oh, no!" She flushed, murmured good-bye and was gone.

When I glanced at the photo copies of a closely-written manuscript I couldn't believe my own eyes. From an electronic computer I had

expected something entirely different: long columns of characters with the values of the argument in the first column and those of the solution in the second.

But what I held in my hand was a strict and precise solution of my equations!

I ran my eye through page after page of calculations that took my breath away with their originality and sheer beauty. Whoever had done it possessed an immense mathematical knowledge to be envied by the world's foremost mathematicians. Almost all the modern armoury of mathematics had been employed: the theory of linear and non-linear differential and integral equations, the theory of the functions of a complex alternating current, and those of groups, and of plurality, and even such apparently irrelevant systems as topology, number theory and mathematical logic.

I nearly cried out in delight when at the end of a synthesis of countless theorems, intermediate calculations, formulae and equations the final solution emerged—a mathematical formula taking up three whole lines.

And to add a touch of the exquisite, the unknown mathematician had given himself the trouble of resolving the long formula into a simpler one. He had found a brief and precise form containing only the more elementary algebraic and trigonometric expressions.

At the very end, on a small inset, there was a graphic representation of the solution.

I could wish for nothing better. An equation which I thought could not be solved in the final form had been solved.

When I had recovered a little from my initial surprise and admiration I went through the photo copies again. Now I noticed that he who had solved my problem had been writing in great hurry and very closely as though trying to save on every scrap of paper and every second of time. Altogether he had written twenty-eight pages and I pictured mentally what a titanic work that had been! Try and pen a letter of twenty-eight closely-written pages in one day or just copy, without following the meaning, twenty-eight pages out of a book, and you will surely find it a hellish job.

But what I had in front of me was not a letter to a friend or a chapter copied out of a book. It was the solution of a most intricate mathematical problem—done in twenty-four hours.

For several hours I studied the closely-written pages, my surprise mounting with each hour.

Where had Kraftstudt found such a mathematician? On what terms? Who was he? A man of genius nobody knew? Or perhaps one of those wonders of human nature that sometimes occur on the border line between the normal and the abnormal? A rare specimen Kraftstudt had unearthed in the Wise Men's Home?

Cases have been recorded of brilliant mathematicians ending their days in a lunatic asylum. Maybe my mathematician was one of those?

These questions plagued me for the rest of that day.

But one thing was clear: the problem had been solved not by a machine, but by a man, a mathematical wizard the world knew nothing about.

The next day, a little calmer, I re-read the whole solution for the sheer pleasure of it this time, just as one will listen again and again to a piece of music one loves. It was so precise, so limpid, so beautiful that I decided to repeat the experiment. I decided to give Kraftstudt Co. one more problem to solve.

That was easy, for I was never short of challenging problems, and I chose an equation which I had always thought impossible to break down so that it could be handled by a computer, let alone be finally solved.

This equation, too, dealt with radio-wave propagation, but it was a specific and very complex case. It was an equation of the type that theoretical physicists evolve for the fun of it and soon forget all about because they are much too complex and therefore of no use to anybody.

I was met by the same young man blinking in the daylight. He gave me a reluctant smile.

"I have another problem—" I began.

Nodding briefly he again led me all the way through the dark corridors to the bleak reception hall.

Knowing the drill now, I went up to the window and handed him my equation.

"So it's not computers that do these things here?"

"As you see," he said without looking up from my equation.

"Whoever solved my first problem is quite a gifted mathematician," I said.

The young man did not say a word, deep as he was in my equation.

"Is he the only one in your employ or have you several?" I asked.

"What has that to do with your requirements? The firm guarantees—"

He had no time to finish, for at that moment the deep silence of the place was shattered by an inhuman scream. I started and listened. The sound was coming from behind the wall beyond the partition. It was like somebody being tortured. Crumpling the sheets with my problem, the young man, throwing a side glance and seizing me by the hand, dragged me to the exit.

"What was that?" I asked, panting.

"You'll have the solution the day after tomorrow, at twelve. You'll pay the bearer."

With those words he left me by my taxi.

3

It is hardly necessary to say that after this event my peace of mind was completely gone. Not for one moment could I forget that terrible scream which had seemed to shake the very stone vaults sheltering Kraftstadt and Co. Besides I was still under the shock of finding such a complicated problem solved by one man in one day. And finally I was feverishly waiting for the solution of my second problem. If this one too was solved, then....

It was with shaking hands that two days later I received a package from the Kraftstadt's girl. By its bulk I could tell that it must contain the solution to the monstrously complicated piece of mathematics. With something akin to awe I stared at the thin creature in front of me. Then I had an idea.

"Please come in, I'll get the money for you."

"No, it's all right." She seemed frightened and in a hurry. "I'll wait outside...."

"Come on in, no point in freezing outside," I said and all but dragged her into the hall. "I must have a look first to see whether the work's worth paying for."

The girl backed against the door and watched me with wide-open eyes.

"It is forbidden..." she whispered.

"What is?"

"To enter clients' flats.... Those are the instructions, sir...."

"Never mind the instructions. I'm the master of this house and nobody will ever know you've entered."

"Oh, sir, but they will, and then...."

"What then?" I said, coming nearer.

"Oh, it's so horrible...."

Her head drooped suddenly and she sobbed.

I put a hand on her shoulder but she recoiled.

"Give me the seven hundred marks at once and I will go."

I held out the money, she snatched it and was gone.

Opening the package I nearly cried out with astonishment. For several minutes I stood there staring at the sheaf of photo paper unable to believe my own eyes. The calculations were done in a *different* hand.

Another mathematical genius! And of greater calibre than the first. The equations he had solved in an analytical form on fifty-three pages were incomparably more complicated than the ones I had handed in die first time. As I peered at the integrals, sums, variations and other symbols of the highest realms of mathematics I had a sudden feeling of having been transferred into a strange mathematical world where difficulty had no meaning. It just didn't exist.

That mathematician, it seemed, had no more difficulty in solving my problem than we have in adding or subtracting two-digit numbers.

Several times I tore myself away from the manuscript to look up a thing in a mathematical manual or reference book. I was amazed by his skill in using the most complex theorems and proofs. His mathematical logic and methods were irreproachable. I did not doubt that had the best mathematicians of all nations and ages, such as Newton, Leibnitz, Gauss, Euler, Lobachevsky, Weierstrass and Hilbert, seen the way my problem had been solved they would have been no less surprised.

When I finished reading the manuscript I fell to thinking.

Where did Kraftstudt get these mathematicians? I was convinced now he had a whole team of them, not just two or three. Surely he couldn't have founded a computer firm employing only two or three men. How had he managed it? Why was his firm next door to a lunatic asylum? Who had uttered that inhuman scream behind the wall? And why?

"Kraftstudt, Kraftstudt..." hammered in my brain. Where and when had I heard that name? What was behind it? I paced up and down my

study, pressing my head with my hands, tasking my memory.

Then I again sat down to that genius-inspired manuscript, delighting in it, re-reading it part by part, losing myself to the world in the complexities of intermediate theorems and formulae. Suddenly I jumped up because I recalled that terrible inhuman scream once more and with it came the name of Kraftstudt.

The association was not fortuitous. No, it was inevitable. The screams of a man tortured and— Kraftstudt! These naturally went together. During the Second World War a Kraftstudt served as investigator in a Nazi concentration camp at Graz. For his part in the murders and inhuman treatment he got a life sentence at the Nuremberg trials.

I remembered the man's photo in all newspapers, in the uniform of an SS Obersturmführer, in a pince-nez, with wide-open, surprised eyes in a plump good-natured face. People wouldn't believe a man with such a face could have been a sadist. Yet detailed evidence and thorough investigation left no room for doubt.

What had happened to him since the trials? Maybe he had been released like many other war criminals?

But what had mathematics to do with it all? What was the connection between a sadistic interrogator and the solutions of differential and integral equations?

At this point the chain of my reasoning snapped, for I was powerless to connect those two links. Obviously there was a link missing somewhere. Some kind of mystery.

Hard as I beat my brains, however, I could think of nothing plausible. And then that girl who said, "They will know." How scared she was!

After a few days of tormenting guess-work. I finally realised that unless I cracked the mystery I would probably crack up myself.

First of all I wanted to make sure that the Kraftstudt in question was that same war criminal.

4

Finding myself at the low door of Kraftstudt and Co. for the third time, I felt that what was to happen next would influence my whole life. For no reason I could understand then or later, I paid off the taxi and rang the bell only after the cab swung round the corner.

It seemed to me that the young man with his crumpled old-mannish face had been waiting for me. Without saying a word he took me by the hand and led me through the dark subterranean maze into the reception hall where I had been on the two previous occasions.

"Well, what brings you here this time?" he asked in what seemed to me a mocking tone of voice.

"I wish to speak to Herr Kraftstudt personally," I demanded.

"Our firm is not satisfying you in some way, Professor?" he asked.

"I wish to speak to Herr Kraftstudt," I insisted, trying not to look into his prominent black eyes, which now shone with malicious mockery.

"As you wish. It's none of my business," he said after a long scrutiny.
"Wait here."

Then he disappeared through one of the doors behind the glass partition.

He was gone over half an hour arid I was dozing off when a rustle came to me from a corner and out of the semi-darkness stepped a white-smocked figure with a stethoscope in hand. "A doctor," flashed through my mind. "Come to examine me. Is this really necessary to see Herr Kraftstudt?"

"Follow me," the doctor said peremptorily and I followed him, having no idea what was to happen next and why I had ever started it.

Light filtered into the long corridor in which we now were through a skylight high up somewhere. The corridor ended with a tall massive door. The doctor stopped.

"Wait here. Herr Kraftstudt will see you presently."

In about five minutes he opened the door wide for me.

"Well, let's go," he said in the tone of a man who was regretting what was going to happen.

I obediently followed him. We entered a wing with large bright windows and I shut my eyes involuntarily.

I was brought out of my momentary stupor by a sharp voice:

"Why don't you come up, Professor Rauch?"

I turned to my right and saw Kraftstudt in a deep wicker-work chair, the very man whom I remembered so well from the newspaper pictures.

"You wished to see me?" he asked, without greeting me or rising from his desk. "What can I do for you?"

I controlled myself with an effort and went right up to his desk.

"So you have changed your occupation?" I asked, looking hard at him. He had aged in those fifteen years and the skin on his face had gathered into large flabby folds.

"What do you mean, Professor?" he asked, looking me over carefully.

"I had thought, Herr Kraftstudt, or rather hoped that you were still...."

"Ah, I see." And he guffawed.

"Times have changed, Rauch. Incidentally, it's not so much your hopes I am interested in at present, as the reasons that brought you here."

"As you can probably guess, Herr Kraftstudt, I have a fair knowledge of mathematics, I mean modern mathematics. I thought at first you had organised an ordinary computer centre equipped with electronic machinery. However I'm now convinced that this is not the case. In your establishment it's men who solve the problems. As only men of genius would solve them. And what is most strange—with monstrous, inhuman speed. If you like, I presumed to come and meet your mathematicians, who are indeed extraordinary men."

Kraftstudt first smiled, then began to laugh quietly, then louder and louder.

"I don't see the joke, Herr Kraftstudt," I said indignantly. "My wish appears ridiculous to you, does it? But don't you realise that anybody with an interest in mathematics would have the same wish on seeing the kind of solution I got from your firm?"

"I'm laughing at something quite different, Rauch. I'm laughing at your provincial narrow-mindedness. I'm laughing at you, Professor, a man respected in the town, whose learnedness has always boggled the imagination of immature maidens and old spinsters, at the way you hopelessly lag behind the swift strides of modern science!"

I was staggered by the insolence of that ex-Nazi interrogator.

"Listen, you," I shouted. "Only fifteen years ago your speciality was applying hot irons to innocent people. What right have you to prattle about swift strides of science? Come to that, I wished to see you to find what methods you use to force the brilliant people in your power to perform work which would take men of genius several years or perhaps all their life to do. I'm very glad I have found you. I consider it my duty as a scientist and citizen to let all the people in our town know that a former Nazi hangman has chosen as his new trade to abase men of science, men whose duty has always been to work for the good of

humanity."

Kraftstudt got up from his chair and, frowning, approached me.

"Listen to me, Rauch. Take my advice and do not provoke me. I knew you would come to me sooner or later. But I never imagined you would be such an idiot. Frankly speaking, I thought I would find in you an ally, so to speak, and a helper."

"What?" I exclaimed- "First you explain to me by what honest or dishonest means you are exploiting the people who bring you profit."

Before my very eyes his face shrunk into a lump of dirty-yellowish skin. The pale-blue eyes behind the pince-nez turned into two slits that bore into me acidly. For a fleeting moment I had a feeling of a thing being examined by a prospective buyer.

"So you want me to explain to you how honestly our firm operates? So you're not satisfied with having your idiotic sums done for you as they should be done in the twentieth century? You want to experience for yourself what it means to be solving such problems?" he hissed, his vile face a mask pulsating with rage and hate.

"I don't believe all is above-board here. Your reputation is proof enough. And then I overheard one of your men screaming—"

"That's enough," Kraftstudt barked. "After all I never asked you to come. But since you are here —and in such a mood—we'll make use of you whether you like it or not."

I had been unaware that the doctor who had brought me there was standing all the time behind me. At a signal from Kraftstudt a muscular hand closed on my mouth, and a piece of cotton soaked in something pungent was thrust under my nose. I lost consciousness.

5

I came to slowly and realised that I was lying stretched on a bed. Voices of men in a heated argument crowded in on me. For a while all I knew was that their subject was scientific. Then, as my head cleared a little, I could understand what it was about.

"I can tell you this: your Nichols is no example. The coding of stimulation is highly individual, you know. What stimulates will-power in one man might stimulate something quite different in another. For instance, an electric impulse that gives Nichols pleasure deafens me.

When I get k I've a feeling two tubes have been thrust into my ears with a couple of aircraft engines revving up at the other end."

"All the same the activity rhythm of neurone groups in the brain doesn't differ much from man to man. That's what our teacher's 'taking advantage of really."

"With not much success though," a tired voice said. "Nothing beyond mathematical analysis so far."

"It's all a matter of time. No short cuts here. Nobody would introduce an electrode into your brain to examine the impulses, because that would damage the brain and consequently the impulses. Now a generator allows for a wide range of change in coded impulses. And that makes for experiments without damage to the brain."

"That's as may be," the tired voice demurred. "The cases of Gorin and Void don't bear you out. The former died within ten seconds of being put inside a frequency-modulated field. The latter screamed with pain, so the generator had to be switched off immediately. You seem to forget the principal thing about neurocybernetics, friends, and that is that the network of neurones in the human body effects immense numbers of synapses. The impulses these transmit have their own frequency. As soon as you are in resonance with this natural frequency your circuit gets tremendously excited. The doctor's probing blindfolded, so to speak. And that we are still alive is pure chance."

At that moment I opened my eyes. I was lying in a room that looked like a large hospital ward with beds lining the walls. In the middle stood a big deal table piled high with remnants of food, empty tins, cigarette stubs and scraps of paper. The scene was lit dimly by electric light. I rose on my elbows and looked round. Immediately the conversation stopped.

"Where am I?" I whispered, looking over the faces staring at me.

A voice whispered, "The new chap's come to."

"Where am I?" I repeated, addressing them all.

"So you don't know?" asked a young man in his underwear, sitting upright in the bed to my right. "This is the firm of Kraftstudt, our creator and teacher."

"Creator and teacher?" I mumbled, rubbing my leaden forehead. "What do you mean—teacher? He's a war criminal."

"Crime is relative. It all depends on the purpose. If the end is noble, any action is good," trotted out my neighbour on the right.

This piece of vulgar Machiavellianism made me look at the man with renewed curiosity.

"Where did you pick up that bit of wisdom, young man?" I said, letting my feet down and facing him.

"Herr Kraftstudt is our creator and teacher," they suddenly began to chant in chorus.

So I have landed in the Wise Men's Home after all, I thought.

"Well, friends, things must be very bad for you to say a thing like that," I said, looking them over again.

"I bet the new boy has his maths in a frequency band between ninety and ninety-five cycles!" a stout fellow shouted, half-rising from his bed.

"And he'll squeal with pain at no more than 140 cycles in the uniformly accelerated pulse code!" bellowed another.

"And he'll be forced to sleep by receiving a series of eight pulses per second with a pause of two seconds after each series!"

"I am certain the new boy will develop ravenous hunger if stimulated at a frequency of 103 cycles with a logarithmic increase in the pulse power."

The worst I could imagine had happened. I was indeed among madmen. The strange thing, however, was that they all seemed to have the same obsession: the possible influence of some kind of codes and pulses on my sensations. They thronged round me goggle-eyed, shouting out figures, giving modulations and powers, betting on how I would act "inside the generator" and "between the walls" and what power I was likely to consume.

Knowing from books that madmen should not be contradicted, I decided not to start any arguments but to try and behave like one of them. So I spoke in as inoffensive a tone as possible to my neighbour on the right. He seemed just a bit more normal than the others.

"Would you please tell me what you're all talking about? I must admit I'm completely ignorant of the subject. All these codes, pulses, neurones, stimulations—"

The room shook to a burst of guffaw. The inmates reeled with laughter, holding their sides, rocking and doubling up. The laughter became hysterical when I rose in indignation to shout them down.

"Circuit Number Fourteen. Frequency eighty-five cycles! Stimulation of anger!" somebody shouted and their laughter crescendoed.

Then I sat on the bed and resolved to wait till they calmed down.

My neighbour on the right was the first to do so. Then he sat on my bed and fixed his eyes on mine.

"Do you mean to say you really don't know anything?"

"Word of honour, not a thing. I can't make head or tail of what you were saying."

"Word of honour?"

"Word of honour."

"All right. We'll believe you, though you're certainly a rare case. Deinis, get up and tell the new boy what we're here for."

"Yes, Deinis, get up and tell him all about it. Let him be as happy as we are."

"Happy?" I asked, surprised. "Are you happy?"

"Of course we are, of course we are," they all shouted. "Why, we know ourselves now. Man's highest bliss is to know himself."

"Didn't you know yourselves before?" I asked.

"Of course not. People don't know themselves. Only those who are familiar with neurocybernetics know themselves."

"Long live our teacher!" someone shouted.

"Long live our teacher!" they all shouted in automatic unison.

The man whom they called Deinis came up and sat down on the bed next to mine.

"What education have you?" he asked in a hollow tired voice.

"I am a professor of physics."

"Do you know anything about neuropsychology?"

"Nothing at all."

"Cybernetics?"

"Almost nothing."

"Neurocybernetics and the general theory of biologic regulation?"

"Not the vaguest idea."

An exclamation of surprise sounded in the room. "Not a chance," Deinis muttered. "He won't understand."

"Go on, please, I'll try my best to follow you." "He'll understand all right after a dozen generator sessions or so," a voice said.

"I understood after five!" someone shouted. "A couple of turns between the walls will be even better."

"Anyway, explain things to me, Deinis," I insisted, fighting down a

terrible premonition. "Well, do you understand what life is?" For a long time I said nothing, staring at Deinis. "Life is a complex natural phenomenon," I uttered at last.

There was a snigger. Then another. Then many more. The inmates of the ward were looking at me as though I had just uttered some obscene nonsense. Deinis shook his head disapprovingly.

"You're in a bad way. You've a lot to learn," he said.

"Tell me where I am wrong."

"Go on, Deinis, explain to him," they all shouted in unison.

"Very well. Listen. Life is constant circulation of coded electrochemical stimulations along the neurones of your organism."

I thought that over. Circulation of stimulations along neurones. I seemed to remember hearing something like that before.

"Well, carry on."

"All the sensations that go to make up your spiritual ego are nothing but electrochemical impulses that travel from receptors up to the brain to be processed, and then down to effectors."

"Yes, well?"

"All sensations of the outer world pass along the nerve fibres to the brain. Each sensation has its own code, frequency and speed. And these three parameters determine its quality, intensity and duration. Understand that?"

"Let's assume I do."

"Hence life is nothing more nor less than the passage of coded information along your nerve fibres. And thought is the circulation of frequency-modulated information through the neurone synapses in the central regions of the nervous system, that is, in the brain."

"I don't quite understand that," I confessed.

"It's like this. The brain is made up of close on ten thousand million neurones similar to electric relays. They are linked up into an elaborately interconnected system by fibres called axones. These conduct stimulation from neurone to neurone. It is this wandering of stimulation along the neurones that we call thought."

My premonition grew to fear.

"He won't understand a thing until he's been inside the generator or between the walls," shouted several voices at once.

"Well, let's assume you're right. What follows from that?" I said to

Deinis.

"That life can be shaped at will. By means of pulse generators stimulating the corresponding codes in the neurone synapses. And that is of enormous practical importance."

"Meaning?" I asked softly, sensing that I was about to get an insight into Kraftstudt and Co.'s activities.

"That can be best explained by an example. Let us consider the stimulation of mathematical activity. Certain backward countries are at present building what are called electronic computers. The number of triggers, or relays, such machines have does not exceed five to ten thousand. The number of triggers in the mathematical areas of the human brain is in the order of one thousand million. Nobody will ever be able to build a machine with anywhere near that number."

"Well, what of it?"

"Here you are: mathematical problems can be solved much more efficiently and cheaply by a mechanism created by Mother Nature and lodged here," Deinis passed his hand across his forehead, "than by any expensive junk built for the job."

"But machines work quicker!" I exclaimed. "A neurone, as far as I remember, can be excited no more than 200 times per second, whereas an electronic trigger can take millions of pulses. That is precisely why fast-working machines are more efficient!"

The ward rocked with laughter again. Deinis alone retained his poker face.

"You're wrong there. Neurones can be made to take impulses at any speed provided the exciter has a sufficiently high frequency. For example, an electrostatic generator operating in the pulsed condition. If you place a brain in the radiation field of such a generator it can be made to work to any speed."

"So that is 'the way Kraftstudt and Co. make their money, is it!" I said, jumping up from the bed.

"He is our teacher!" they all chanted again. "Repeat it, new boy. He is our teacher!"

"Leave him," Deinis ordered suddenly. "He will understand in time that Herr Kraftstudt is our teacher. He doesn't know anything yet. Listen to this, new boy. Every sensation has its own code, its intensity and duration. The sensation of happiness—55 cycles per second with coded

series of one hundred pulses each. The sensation of grief—62 cycles with a pause of 0.1 second between pulses. The sensation of joy—47 cycles with pulses increasing in intensity. The sensation of sadness—203 cycles, pain—123 cycles, love—14 cycles, poetic mood—31, anger—85, fatigue—17, sleepiness—eight, and so on. Coded pulses in these frequencies move along the neurones and thus you experience all the sensations I've mentioned. They can all be produced by a pulse generator created by our teacher. He has opened our eyes to the meaning of life."

These explanations made me giddy. I didn't know what to think. The man was either as mad as a hatter or really giving me a glimpse into mankind's future. I was still dizzy from the after-effects of the drug I'd been given in Kraftstudt's study. A wave of weariness swept over me, I lay back and closed my eyes.

"He's under frequency seven to eight cycles! He wants to sleep!" someone shouted.

"Let him have his sleep. Tomorrow he'll start learning life. They'll take him inside the generator tomorrow."

"No, he'll have his spectre recorded tomorrow. He might have abnormalities."

That was the last thing I heard. I slid into deep sleep.

The man I met the next day at first appeared to me quite pleasant and intelligent. When I was led into his study up a floor in the firm's main building he came forward to meet me, smiling broadly, hand stretched out in greeting.

"Ah, Professor Rauch. I'm indeed pleased to meet you."

Returning his greeting with restraint I inquired after his name.

"My name is Boltz, Hans Boltz. Our chief has given me an embarrassing commission—that of extending apologies to you in his name."

"Apologies? Is your chief really subject to pangs of conscience?"

"I don't know. I'm sure I don't know, Rauch. Anyway, he's extending his most sincere apologies to you for all that has happened. He lost his temper. He doesn't like being reminded of the past, you know."

I smiled wryly.

"Why, I did not come with any intention of raking in his past. My interest lay elsewhere. I wanted to meet those who so brilliantly solved—"

"Pray, be seated, Professor. That is exactly what I was going to speak to you about."

I settled in the proffered chair and studied the broadly smiling face behind the large desk. Boltz was a typical north-country German with an elongated face, fair hair and large blue eyes. His fingers were playing with a cigarette-case.

"I'm in charge of the maths department here," he said.

"You? Are you a mathematician?"

"Yes, in a way. At least I have a smattering of it."

"That means I can meet some of them through you?"

"You've already met all of them, Rauch," Boltz said.

I stared at him blank-eyed.

"You've spent a day and night with them."

I remembered the ward and its inmates with their nonsense about impulses and codes.

"Do you expect me to believe those crackpots are the brilliant mathematicians who solved my equations?"

Not waiting for a reply I broke into laughter.

"And yet they are, indeed. Your last problem was solved by a certain Deinis. As far as I know the same individual who last night gave you a lecture on neurocybernetics."

After a few moments' thought I said:

"In that case I don't understand anything. Perhaps you would explain it all to me?"

"With pleasure. Only after you've seen this." And Boltz offered me the morning paper.

I unfolded it slowly and suddenly jumped up. Looking at me from the first page was ... my own face framed in black. Over it was the banner caption: "Tragic death of Dr. Rauoh."

"What's the meaning of this, Boltz? What sort of farce is this?" I expostulated.

"Please calm yourself. It's all quite simple really. Last night when crossing the bridge over the river on your way home from a walk near the lake, you were attacked by two escaped lunatics from the Wise Men's Home, killed, mutilated and thrown into the river. Early this morning a corpse was discovered at the dam. The clothes, personal belongings and papers helped to identify the corpse as yours. The police called at the

Home this morning and have pieced together a complete picture of your tragic death."

It was only then I looked at my clothes and realised that the suit I had on was not mine; I dived into my pockets, all the things I'd had on me were gone.

"But this is preposterous—"

"Yes, of course, I quite agree. But what can be done, Rauch, what can be done? Without you Kraftstudt and Co. may suffer a serious setback — go bust, if you like. I don't mind telling you that we are up to our eyebrows in orders. They're all military and extremely valuable. And that means round-the-clock computing. Since we completed the first batch of problems for the Defence Ministry business has just snowballed, you could say."

"And you want me to become another Deinis for you?"

"Oh, no, Rauch. Of course not."

"Then why that farce?"

"We need you as instructor in mathematics."

"Instructor?" I jumped up again, staring wildly at Boltz. He lighted a cigarette for himself and nodded at my chair. I sat down, completely bewildered.

"We need new mathematicians, Professor Rauch. Either we get them or we'll very soon be on the rocks."

I stared at the man who did not seem to me half as pleasant now as he'd done before. I seemed to discern traits of innate bestiality in him, faint, but coming to the fore now.

"Well, what if I refuse?" I asked. "That would be just too bad. I'm afraid you'd have to join our—er—computer force then." "Is that so bad?" I asked.

"It is," Boltz said firmly, standing up. "That would mean you'd finish your days in the Wise Men's Home."

Pacing up and down the room, Boltz began to speak in the tones of a lecturer addressing an audience:

"The computing abilities of the human brain are several hundred thousand times those of an electronic computer. A thousand million mathematical nerve cells plus the aids—memory, inhibition, logic, intuition, etc.—place the brain high above any conceivable machine. Yet the machine has one essential advantage."

"Which?" I asked, still not understanding what Boltz was driving at.

"If, say, a trigger or a group of triggers is out of order in an electronic machine, you can replace the valves, resistors or capacitors and the machine will work again. But if a nerve cell or a group of nerve cells in the computing area is out of order, replacement, alas, is impossible. Unfortunately we are obliged to make brain triggers work at an increased tempo here. As a result, wear and tear, if I may call it so, is greatly accelerated. The living computers are soon used up arid then—"

"What then?"

"Then the computer gets into the Home."

"But that's inhuman—and criminal," I said hotly.

Boltz stopped in front of me, placed a hand on my shoulder and, with a broad smile, said:

"Rauch, you've got to forget all those words and notions here. If you won't forget them yourself we'll have to erase them from your memory for you."

"You will never be able to do that!" I shouted, brushing away his hand.

"Deinis's lecture was wasted on you, I see. Pity. He spoke sense. Incidentally, d'you know what memory is?"

"What has that to do with our subject? Why the hell are you all buffooning here? Why—?"

"Memory, Professor Rauch, is prolonged stimulation in a group of neurones due to a positive reverse connection. In other words, memory is the electrochemical stimulation that circulates in a given group of nerve cells in your head. You, as a physicist interested in electromagnetic processes in complex media, must realise that by placing your head in the appropriate electromagnetic field we can stop that circulation in any group of neurones. Nothing could be simpler! We can not only make you forget what you know, but make you recall what you have never known. However it's not in our interests to resort to these—er—artificial means. We hope your common sense will prevail. The firm will be making over to you a sizeable share of its dividends."

"For what services?"

"I've already told you—for teaching mathematics. We sign up classes of twenty to thirty people with an aptitude for maths—this country has an abundance of unemployed, fortunately. Then we teach them higher

mathematics in the course of two to three months—"

"But that's impossible," I said, "absolutely impossible. In such a short time, I mean...."

"It's *not* impossible, Rauch. Don't forget you'll be dealing with a very bright audience, uncommonly intelligent and possessing a wonderful memory for figures. We will see to that. That is in our power."

"Also by artificial means? By means of the pulse generator?" I asked.

Boltz nodded.

'Well, do you agree?"

I shut my eyes tightly and thought hard. So Deinis and the others in the ward were normal people and had been telling me the truth yesterday. So Kraftstudt and Go. had really developed a technique of commercialising human thought, will-power and emotions by means of electromagnetic fields. I sensed Boltz's searching glance on me and knew I must hurry with my decision. It was devilishly hard to make. If I agreed I'd be speeding my students on their way to the Wise Men's Home. If I refused I'd do the same to myself.

"Do you agree?" Boltz repeated, touching me on the shoulder.

"No," I said, my mind made up. "No. I can be no accomplice to such abomination."

"As you wish," he said with a sigh. "I'm very sorry, though."

After a minute's silence he stood up briskly, went over to the door and, opening it, called out:

"Eider, Schrank, come in here!"

"What are you going to do to me?" I asked, also getting up.

"To begin with we'll record the pulse-code spectre of your nervous system."

"Which means?"

"Which means we'll record the form, intensity and frequency of the pulses responsible for your every emotional and intellectual state and make them into a chart."

"But I won't let you. I will protest. I—"

"Show the Professor the way to the test laboratory," Boltz cut in indifferently and turned his back on me to look out of the window.

As I entered the test laboratory I had already formed the decision which was to play a crucial role in the events that followed. My line of reasoning was this. They are going to subject me to a test that will give

Kraftstudt and his gang complete information on my inner self. They need this to know what electromagnetic influence to bring to bear on my nervous system to produce any emotion or sensation they want. If they are fully successful I'll be in their power beyond hope of escape. If they are not I'll retain a certain amount of free play. Which I might soon badly need. So the only hope for me is to try to fool those gangsters as much as possible. That I can' do so to a degree I deduced from what a slave of Kraftstudt's said yesterday about pulse-code characteristics being individual, except where mathematical thought is concerned.

I was led into a large room cluttered up with bulky instrumentation, the whole looking like the control room of a power station. The middle of the laboratory was taken up by a control console with instrument panels and dials. To its left, behind a screen of wire mesh, towered a transformer, several generator lamps glowing red in white porcelain panels. Fixed to the wire mesh which served as a screen-grid for the generator were a voltmeter and an ammeter. Their readings were used, apparently, to measure the generator's output. Close by the control console stood a cylindrical booth made up of two metallic parts, top and bottom.

As I was led up to the booth two men rose from behind the console. One of them was the same doctor who had taken me to Kraftstudt the day before, the other—a wizened old man whom I didn't know, with sparse hair disciplined into perfect smoothness on a yellow crane.

"Failed to persuade him," the doctor said. "I knew as much. I could see at once that Rauch belonged to the strong type. You will come to a bad end, Rauch," he said to me.

"So will you," I said.

"That's as may be, but with you it's definite."

I shrugged.

"Will you go through it voluntarily or do you want us to force you?" he then asked, looking me over insolently.

"Voluntarily. As a physicist I'm even interested."

"Splendid. In that case remove your shoes and strip to the waist. I must examine you first and take your blood pressure."

I did as I was told. The first part of "registering the spectre" looked like an ordinary medical check-up—breathe, stop breathing and the rest of it.

When the examination was over the doctor said:

"Now step into the booth. You've got a mike there. Answer all my questions. I must warn you that one of the frequencies will make you feel an intense pain. But it will go as soon as you yell out."

In my bare feet I stepped on to the porcelain floor. An electric bulb flashed on overhead. The generator droned. It was operating in the low-frequency band. The tension of the field was obviously very high. I felt this by the way waves of warmth swelled and ebbed slowly through my body. Each electromagnetic pulse brought with it a strange tickling in the joints. Then my muscles began contracting and relaxing in time to the pulses.

Presently the frequency of the warmth waves was increased.

Here it goes, I thought. If only I can bear it. When the frequency reached eight cycles per second I would want to sleep. If only I could fight it. If only I could fool the blackguards. The frequency was slowly increasing. In my mind I counted the number of warm tides per second. One, two, three, four, more, still more. . . . Then sleepiness was on me with overwhelming sudden-ness. I clamped my teeth together, willing myself into wakefulness. Sleep was pushing me under like an enormous clammy weight, bearing me down, loading my eyelids. It was a miracle I was still on my feet. I bit my tongue, hoping pain would help me throw off the nightmarish burden of sleep. At that moment, as if from afar, a voice came to me:

"Rauch, how do you feel?"

"Not bad, thank you. A bit cold," I lied. I didn't recognise my own voice and bit my lips and tongue as hard as I could.

"Don't you feel sleepy?"

"No," I said, though I thought I would drop into sleep the next moment. And then, abruptly, all sleepiness was gone. The frequency must have been increased beyond the first terminal threshold. I felt fresh and cheerful as after a good snooze. Now I must fall asleep, I thought, and, shutting my eyes, snored away. I heard the doctor say to his assistant:

"Odd. Sleep at ten cycles instead of eight and a half. Write it down, Pfaff," he told the old man. "Rauch, your sensations?"

I didn't reply, still snoring loudly, my muscles relaxed, knees stuck against the side of the booth.

"Let's go on with it," said the doctor. "Increase the frequency, Pfaff, will you."

In a second I "woke up". The frequency band through which I was now passing made me experience a whole gamut of emotions and changes of mood. I was sad, then gay, then happy, then utterly miserable.

"Time I yelled out," I suddenly decided.

At the moment the generator's roar increased I yelled all I could, whereupon the doctor immediately ordered:

"Cut the tension! It's the first time I've met such a crazy type. Write down: pain at seventy-five cycles per second when normal people experience it at one hundred and thirty. Go on."

That frequency is still in store for me, I thought in dread. Will I be able to cope with it?

"Now, Pfaff, try the ninety-three on him."

When the frequency stabilised something entirely unexpected happened to me. I suddenly remembered the equations which had brought me to Kraftstudt and with perfect clarity visualised every stage of their solution. This is the frequency which stimulates mathematical thinking, I thought fleetingly.

"Rauch, name the first five members of the Bessel function of the second order," the doctor demanded.

I rattled off the answer. My head was crystal clear and my whole being was permeated with a wonderful feeling of knowing all and having it on my tongue's tip.

"Name the first ten places of it."

I named them.

"Solve a cubic equation."

The doctor dictated one with unwieldy fractional coefficients.

In two or three seconds I had the solution ready, naming all the three roots.

"Let's go on. He's quite normal in this department."

Slowly the frequency increased and I felt maudlin. There was a lump in my throat and tears welled in my eyes. But I laughed. I roared with convulsive laughter as if being vigorously tickled. I laughed, while the tears rolled down my cheeks.

"Some idiotic idiosyncrasy again. In a class of his own, you might say. I at once knew him for a strong nervous type subject to neuroses. When

will he winge, I wonder?"

I "winged" when weeping was farthest from my mood, when all of a sudden my heart was overflowing with buoyant happiness as a nuptial cup with good vine. I wanted to troll and laugh and dance for joy. All of them—Kraftstudt and Boltz and Deinis and the doctor—seemed to me capital fellows, the jolliest chaps I had ever met. It was then that, with great effort, I started to whimper and blow my nose loudly. Though ghastly inadequate, my weeping soon elicited the now familiar comments of the expert:

"Oh, what a type. All upside down. Nothing even remotely resembling the normal spectre. This fellow will give us a lot of trouble."

How far is the one hundred and thirty? I thought, in abject terror, when the happy and carefree sensation had given way to a feeling of worry, ungrounded anxiety, the presage of impending doom.... I started humming a tune. I was doing it mechanically, with a great effort, while my heart pounded away in premonition of something terrible, something fatal and inevitable.

I at once knew when the frequency approached the one stimulating the sensation of pain. At first there was just a dull ache in the joints of the thumb on my right hand, then a sharp pain seared through an old wartime wound. This was followed by a terrible toothache spreading at once to all the teeth. Then a splitting headache added.

Blood pulsed painfully in my ears. Shall I be able to stand it? Shall I have enough will-power to overcome the nightmarish pain and not show it? People have been known after all to be done to death in torture chambers without groaning once. History has recorded cases of people dying on the faggots mute....

The pain went on increasing. Finally it reached its peak and my whole body became one knot of gnawing, stinging, racking, throbbing, excruciating pain. I was all but unconscious and saw purple specks revolving before my eyes, but I remained silent.

"Your sensations, Rauch," the doctor's voice penetrated to me.

"A sensation of murderous rage," I muttered through clenched teeth. "If I only could lay my hands on you...."

"Let's go on. He's completely abnormal. Everything's the other way round with him."

And when I was on the verge of passing out, ready to scream or groan, all pain was suddenly gone. There was sweat, clammy and cold, all over my body. My every muscle trembled.

Later some frequency made me see a blinding light which was there even when I shut my eyes, then I experienced wolfish hunger, heard a scale of deafening noises, felt cold as if taken out into the frost without a stitch on. But I persisted in giving the doctor wrong answers until he fumed with rage. I knew I still had one of the most terrible tests mentioned in the ward the day before coming to me: loss of will-power. It was will that had seen me through so far. It was this invisible inner force that had helped me fight the sensations created artificially by my tormentors. But they would get at it eventually with their hellish pulse generator. Now, would they be able to find I had lost it? I waited for that frequency in dread. And it came.

Suddenly I felt indifference. Indifference to being in the hands of the Kraftstudt gang, indifference to him and his associates, indifference to myself. My mind was a complete blank. The muscles felt flabby. All sensations were gone. It was a state of total physical and moral spinelessness. I couldn't force myself to think or make the slightest movement. I had no will of my own.

And yet, surviving in some remote corner of my consciousness, a tiny thought insisted: You must ... you must ... you must.

You must what? Why? Whatever for? "You must ... you must ... you must," kept on insisting what seemed to me a single nerve cell by some kind of miracle impervious to the all-powerful electromagnetic pulses that held sway over my nerves, bidding them to feel whatever those hangmen wanted.

Later, when I learned about the theory of the central encephalic system of brain activity, according to which all the nerve cells in the cortex are governed by a single, master group of nerve cells, I realised that this supreme psychic authority was impervious even to the strongest outside physical and chemical influences. That must be what saved me then.

Suddenly the doctor ordered:

"You will collaborate with Kraftstudt."

I said:

"No."

"You will do all that you are told to do."

"No."

"Run your head against the wall."

"No."

"Let's go on. He's abnormal, Pfaff, but mind you we'll get at him yet."

I shammed loss of will-power just when a sensation of the strongest will flooded my whole being and I felt I could make myself do the impossible.

Checking on my "abnormalities" the doctor put me a few more questions.

"If the happiness of mankind depended on your life, would you give it?"

"Why should I?" I asked dully.

"Can you commit suicide?"

"Yes."

"Do you want to kill the war criminal, Obersturmfuhrer Kraftstudt?"

"What for?"

"Will you collaborate with us?"

"Yes."

"Damned if I can make anything out of him! I hope it's the first and the last time I have such a case to deal with. Loss of will-power at 175. Write that down. Let's go on with it."

And they went on for another half-hour. Finally the frequency chart of my nervous system was complete. The doctor now knew all the frequencies by means of which I could be made to experience any sensation or mood. At least he thought he did. Actually the only genuine frequency was the one which stimulated my mathematical abilities. And that was just what I needed most. The point was that I had evolved a plan of blowing the criminal firm sky-high. And mathematics was to be my dynamite.

It is an established fact that hypnosis and suggestion work best on weak-willed individuals. That was how the Kraftstudt personnel instilled in the calculators—their wills generator-treated—awed obedience and reverence towards their "teacher".

I, too, was to pass through an obedience course, but because of my "abnormal" spectre this was postponed for a time. I required an individual approach.

While a working place was being specially set up for me I had

comparative freedom to move about. I was allowed to go out of the ward into the corridor and glance into the class-rooms where my colleagues studied or worked.

I was not allowed to join in the common prayers held between the walls of a huge aluminium condenser for half an hour every morning, during which Kraftstudt's victims paid homage to the firm's head. Devoid of will and thought, they dully repeated words read to them over a closed-circuit broadcast system.

"Joy and happiness lie in self-knowledge," announced the relayed voice.

"Joy and happiness lie in self-knowledge," the twelve men on bended knees repeated in chorus, their will-power destroyed by the alternating current field "between the walls".

"By understanding the mysteries of the circulation of impulses across neurone synapses we achieve joy and happiness."

"... joy and happiness," repeated the chorus.

"How wonderful that everything is so simple!"

What a delight it is to know that love, fear, pain, hatred, hunger, sorrow, joy are all nothing but movement of electrochemical impulses in our bodies!"

"... in our bodies."

"How miserable he who does not know this great truth!"

"... this great truth," repeated the slaves dully.

"Herr Kraftstudt, our teacher and saviour, gave us this happiness!"

"... happiness."

"He gave us life."

"He gave us life."

I listened to this monstrous prayer, peeping through the glass-panel door of a class-room.

Inert and flabby, with eyes half-closed, the men repeated the nightmarish maxims in expressionless voices. The electric generator hardly ten paces away pumped submission into their minds robbed of resistance. Something inhuman, vile to the extreme, bestial and at the same time exquisitely cruel was being done to them. Boggled for comparison at the sight of that herd of miserable creatures with no will of their own, my mind could only suggest dipsomania or drug-addiction at their worst.

The thanksgiving over, the twelve passed into a spacious hall with rows of desks. Suspended over each desk was a round plate of aluminium forming part of a mammoth condenser. A second plate was apparently sunk in the floor.

This hall reminded me somehow of an open-air cafe with shaded tables. But the idyllic impression was swept away as soon as I looked at the men under the plates.

A sheet of paper setting out the problem awaited each one of them. At first the calculators looked at these in dumb incomprehension, still under the influence of the will-destroying frequency. Presently the frequency of ninety-three cycles was switched on and a crisp order to begin work relayed.

And all the twelve, snapping up pad and pencil, pitched into feverish scribbling. This could not be called work. It was frenzy, a kind of mathematical epilepsy. The men writhed and squirmed over their pads, their hands shuttled to and fro till they blurred; their faces turned deep purple with the strain; their eyes started out of their sockets.

This lasted for the best part of an hour. Then, when their hands started moving jerkily, heads lowered almost to the table-tops and livid veins swelled rope-like in their extended necks, the generator was switched to eight cycles. All the twelve at once dropped asleep.

Kraftstudt saw to it that his slaves got some rest!

Then it all began afresh.

One day, while watching this horrible scene of mass mathematical frenzy I saw one of the calculators break down. Suddenly he stopped writing, crazily turned to one of his furiously writing neighbours and stared at him blankly for a while as if at great pains to remember something.

Then he gave a terrible guttural cry and began tearing his clothes. He bit himself, gnawed at his fingers, tore skin off his chest, battered his head on the table. Finally he passed out and slumped down on the floor.

The rest paid not the slightest attention, their pencils still working feverishly.

I was so enraged that I started pounding on the locked door. I wanted to call out to the poor devils, tell them to have done with it, to break out and fall on their tormentors. . . .

"Don't get so worked up, Herr Rauch," I heard a calm voice beside me.

It was Boltz.

"You are criminals! Look what you're doing to people. What right have you to torture them?"

He smiled his bland intellectual smile and said:

"Do you remember the myth about Ulysses? The gods offered him the choice between a long but quiet life and a short but turbulent one. He chose the latter. So did those men."

"But they were not offered any choice. It's you who aided by your pulse generator chose to stampede them toward self-annihilation for the sake of dividends!"

Boltz laughed.

"Haven't you heard them say they are happy? And so they are. Look at the way they're working in happy abandon. Does not bliss lie in creative labour?"

"I find your arguments revolting. There is a normal tempo in human life and it is criminal to try to accelerate it."

Boltz laughed again.

"You're not exactly logical, Professor. There was a time when people travelled on foot or horseback. Nowadays they fly by jet. News used to spread from mouth to mouth, taking years to snail-pace round the globe; now radio brings events right into your home even as they happen. Present-day civilisation accelerates the tempo of life artificially and you don't think it's a crime. And the host of all sorts of artificial amusements and delights, aren't they too accelerating life's tempo? So why should you consider artificial acceleration of the functions of a living organism a crime? I'm certain that these people, were they to live a natural life, would not be able to do a millionth part of what they can do now. And the meaning of life, as you know, is creative activity. You will fully appreciate that when you become one of them. Soon you will know what joy and happiness are! In fact, in two days' time. A separate room is being set up for you. You will be working there alone, because, you will excuse my saying so, you are somewhat different from normal people."

Boltz slapped me amiably on the shoulder and left me alone to ponder his inhuman philosophy.

In accordance with my "spectre" they started my obedience training at a frequency which gave me enough will-power to achieve a feat of defiance. My first feat was easy: again I shammed loss of will-power.

Kneeling down and staring ahead as vacuum-eyed as I possibly could, I repeated dully the now familiar thanksgiving balderdash. In addition a few truths about neuro-cybernetics were inculcated in me as a novice.

They boiled down to remembering which frequencies stood for what human emotions. Out of these, two were particularly important for my plans: the one stimulating mathematical thinking and another, which, luckily, was not far from the ninety-three cycles.

My training lasted for a week, after which time I was deemed obedient enough to be put to work. The first problem I was given was analysing the possibility of intercepting an IGBM.

It took me two hours to do. The result was not cheerful for the Ministry: it couldn't be done under the conditions indicated.

The second problem, also of a military nature, was calculating a neutron beam powerful enough to set off an enemy's nuclear war-heads. The answer was again cheerless. A neutron cannon as calculated would have to weigh several thousand tons.

It was indeed a delight for me to solve those problems and I must have looked as possessed as the other calculators, with the difference, however, that the generator, instead of making me an obedient tool, was infusing me with confidence and enthusiasm. A joyous feeling of being on top of the world did not leave me even during the sleep breaks. I pretended to sleep but in reality I was working out my plans of condign punishment.

When I was through with the Defence Ministry problems I began to solve in my mind (so that nobody would know) the problem most important for me, how to blow Kraftstudt and Co. sky-high.

I meant the phrase metaphorically, of course, having no dynamite and no chance of obtaining any in that prison-like madhouse. Anyway blasting was no part of my plan.

Since the pulse generator could stimulate any human emotion, why not try to use it, I reasoned, to rouse human dignity in its victims and make them rebel against the ex-Nazi criminals? If this were possible they would require no outside help to smash this scientifically-minded gang. But was there a way to do it? Was there a way, that is, to change the frequency stimulating mathematical thinking for one that unleashed anger and hatred in man?

The generator was operated by its aged creator, Dr. Pfaff, an able

engineer but apparently with a strong sadistic streak. As he obviously delighted in the perverse way his creation was used, I could not count on any help from him. Dr. Pfaff was absolutely out. The generator had to work on the frequency I required without his help or knowledge.

Now if a pulse generator is overloaded, that is, if more power is taken off than its design allows, the frequency drops. That means that by adding an extra load in the form of a resister, a generator can be made to operate on a frequency lower than shown on the dial.

Kraftstudt and Co. exploited mathematical thinking at a frequency of 93 cycles per second. Anger is produced by 85. That meant the frequency had to be cut down by a total of eight cycles! I started calculating an extra load to do that.

During my visit to the test laboratory I had noted the readings on the voltmeter and ammeter of the generator. Their product gave me its power. Now for the mathematical problem of an extra load....

I first traced in my mind the way the gigantic condensers inside which those poor devils slaved were connected to the generator. Then, in forty minutes, I solved the pertinent Maxwell equations and did all the other, most complex calculations.

It appeared Herr Pfaff had an excess of power of only one-and-a-half watts!

This was sufficient to calculate how a frequency of ninety-three cycles could be changed to one of eighty-five. All I had to do was to earth one of the condenser-plates through a resister of 1,350 ohms.

I nearly shouted with joy. But where could I get a length of wire of that resistance? I thought next. It had to be very exact, too, or the desired effect would not be achieved.

I feverishly cast my mind about for substitutes but could think of none. A feeling of impotence swept over me when a black plastic cup suddenly appeared in my field of vision in the act of being placed on my desk by a small trembling hand. I looked up and could barely suppress an exclamation of surprise: standing in front of me was the thin girl with frightened eyes, the one who had delivered the Kraftstudt mail to me.

"What are you doing here?" I asked under my breath.

"Working," she answered, hardly moving her lips. "So you're alive."

"Yes. I need you."

Her eyes darted about.

"Everyone in town thinks you were killed. So did I."

"You go to town?"

"Yes. Almost every day, but...." I caught her tiny hand and held it in wine. "Tell everybody in town, especially at the University, I'm alive and kept here by force. Tell them this tonight. My friends here and myself must get help to get out."

There was terror in the girl's eyes. "What are you saying?" she whispered. "If Hen-Kraftstudt gets to know, and he can find out anything...."'

"How often are you interrogated?" "Next time will be the day after tomorrow." "You've got a whole day. Screw up your courage. Don't be afraid. Do as I tell you, please." The girl snatched her hand away and hurried out.

There were pencils in the black cup. Ten of them altogether, of different colours for different purposes. Mechanically I took the first that came to my hand and fingered it: it was marked "2B", a very soft pencil. It had plenty of graphite, a fair conductor. Then came "3B" and "5B" pencils, then those of the "H" range, hard ones, for copying. As I fingered them my mind seethed in a turmoil of speculation. Then all of a sudden, like a flash of lightning, I remembered the specific resistances of pencil graphites: A "5H" pencil has a resistance of 2,000 ohms. The next moment I had a "5H" pencil in my hand. The problem was solved now not only mathematically but practically. There in my hand was a length of wood-enclosed graphite with the help of which I could bring punishment to a gang of modern barbarians.

I secreted the pencil in an inner pocket as carefully as a priceless treasure. Then it occurred to me where I could get two pieces of wire, one to connect to the condenser-plate over my desk, the other to the radiator in the corner, with the pencil graphite in between.

I remembered the table lamp in the ward where I lived with the other calculators. It had a flex which, being about five feet long, could be unwound into a forty-foot length of thin wire, which would be more than enough for the job.

I had just finished my calculations when the relayed voice announced dinnertime for the calculators.

I left my solitary cell in high spirits and made for the ward. Glancing back in the corridor, I saw the doctor look with obvious displeasure at

the solutions of the problems I'd been given. Apparently the fact that there was no way of intercepting an ICBM or setting off the enemy's atomic bombs by a-neutron cannon was not to his liking. He had no premonition though of what *could* be done with ordinary graphite from a copying pencil!

The table lamp I had in mind had not apparently been in use for a long time. It stood in a corner on a high stool, dusty, fly-specked, its flex coiled tight round the upright.

Early in the morning when the inmates filed out to wash, I cut off the flex with a table knife and put it in my pocket. At breakfast I pocketed a knife and when everybody went out for the prayer I locked myself in the toilet. In a matter of seconds I had skinned off the insulation sheath and exposed numerous strands of thin wire, each about five feet long. Then I split the pencil gingerly, took out the graphite core and broke off three-tenths of its length. The remaining part should have the resistance I required. I made tiny notches at either end of the graphite where I secured the wires. The resister was ready. All that remained to be done was to connect it to the condenser-plate and then earth it.

That I could do during my work.

The calculators had an eight-hour working day with ten-minute breaks after each hour. After the lunch break, at 1 p.m., the hall where they worked was as a rule visited by the Kraftstudt and Co. executives. The head of the firm used to linger in the hall for some time, obviously enjoying the sight of twelve men writhing in mathematical throes. I decided it was the best time to change the frequency.

I went to my place of work that morning with the resister all ready in my pocket. I was walking on air. At the door I met the doctor. He had brought my problems for the day.

"Hey, sawbones, wait a minute," I called out to him.

He stopped in his tracks and looked me over, astonished.

"I'd like a word with you."

"Well, what is it?" he grunted.

"It's like this," I began. "It occurred to me while I was working yesterday to return to a conversation I had with Herr Boltz. I think I was rather rash. I wonder if you would let Herr Boltz know that I agree to teach maths to the firm's new draft."

"Good for you," he said with sincerity. "I told them that your spectre

being what it is you should be set up as an overseer over that mathematical manure. We badly need an efficient overseer. Your working frequencies are all different. You could just walk among them and drive the lazy or those who have slipped out of resonance."

"Why, of course, doctor. But I think I'd better stick to teaching. God witness I don't feel like; bashing my head against a table-top like I saw a chap do the other day."

"Very sensible," he agreed. "I'll be speaking to Kraftstudt. I think he will agree."

"When will I know his decision?"

"By one o'clock, I expect, when we make our round of the premises."

"Good. With your permission I'll approach you then."

He nodded and walked off. On my desk I found a sheet of paper which gave me conditions for the calculation of a new pulse generator four times more powerful than the existing one. So Kraftstudt thinks of expanding his business, I thought. Yoking to it fifty-two calculators instead of the thirteen he has now. Almost lovingly I touched the pencil graphite with bits of wire in my pocket to make sure it hadn't broken.

The conditions of the problem showed me that my calculations in connection with the existing generator were correct. My hopes for success soared. I began looking forward to lunch break. When the clock on the wall showed a quarter to one I took out my device and connected its one end to a bolt on the aluminium plate above my' desk. The other end I lengthened with more pieces of wire until it was long enough to reach the radiator in the corner of the room.

The last minutes dragged painfully. At last the minute hand touched twelve. I quickly connected the wire to the radiator and strode into the corridor. Advancing towards me was Kraftstudt with Pfaff, Boltz and the doctor in attendance. At the sight of me they broke into smiles. Boltz motioned me to join them. I did so and we all stopped at the glass door of the room where the calculators worked.

Pfaff and Kraftstudt were in front and I couldn't see what was going on inside.

"That was a wise move," Boltz whispered to' me. "Herr Kraftstudt has accepted your offer. You won't regret it—"

"What's the matter?" Kraftstudt asked suddenly, turning on his retinue. Engineer Pfaff cowered; looking through the door with an odd

expression on his face. My heart missed a beat.

"They're not working! They're staring about, damn 'em!" Pfaff growled.

I pressed forward and looked through the glass panel. What I saw surpassed my wildest hopes. The men who before had bent so obediently over their desks were sitting upright now, looking about them boldly and speaking to one another in loud, resolute voices.

"It's time we put an end to it, boys. D'you realise what they're doing to us?" Deinis was saying aggressively.

"Of course we do. They've been drumming into us that we achieve happiness through their pulse generator, the bastards. I've a mind to help 'em achieve theirs!"

"What's happening there?" Kraftstudt queried threateningly.

"I've no idea," Pfaff mumbled, rolling his faded eyes. "They act as if they were normal! Why don't they go on with their work?" Kraftstudt was livid by now. "We won't be on time with at least five defence orders," he said through clenched teeth. "See that they-immediately-start working!".

Boltz snapped the lock open and our party trooped in.

"Stand up to greet your teacher and saviour," Boltz said loudly.

A pregnant silence was the answer. Twelve pairs of eyes full of anger and hatred blazed in our direction. A spark was enough now to set it off. My heart sang with joy. Kraftstudt Co. was about to bust! I stepped forward.

"What are you waiting for? The hour of delivery has come. Your happiness is in your own hands. Go on, smash this criminal gang who wanted to see you all in the madhouse!"

No sooner had I finished than the calculators rushed from their places and fell on the petrified Kraftstudt and his party. They bore Boltz and the doctor down and started throttling them. They cornered Kraftstudt, punching and kicking him. Deinis straddled over the prone Pfaff and seizing his bald head by its ears drummed it against the floor. Some tore the aluminium awnings down, others smashed window-panes. The loudspeaker torn down by a calculator crashed to the floor, followed by the desks. The floor was strewn with sheets of calculations torn to bits.

I stood in the centre of that battle-field, issuing commands:

"Now don't let Kraftstudt get away! He's a war criminal! He's the

kingpin of this hell on earth where you've been worked to madness! Hold tight that scoundrel Pfaff! He designed that pulse generator! Give Boltz what he deserves! He recruited you and planned to recruit many more!"

And the men, splendid in their righteous wrath, punched, kicked and throttled their enemies. .

Though no longer under the influence of the generator they could not stop now in their noble indignation of people breaking free from thraldom. Kraftstudt and his party, torn and bleeding, were dragged into the corridor and to the exit.

I led the agitated men, hooting and jeering and cursing their former masters, through the win-dowless reception hall where I'd handed in my problems, through the narrow subterranean maze to the back door where we finally emerged into the open.

"We were blinded momentarily by a hot spring sun and we stopped short. But not only because of the sun. In front of the door leading to Kraftstudt's apartments pressed a huge crowd of people. They had been shouting something but at the sight of us suddenly went silent. Then I heard somebody call out:

"Why, this is Professor Rauch! So he is really alive!"

Deinis and his colleagues kicked forward the battered executives of Kraftstudt and Co. One after another they struggled to their feet and glanced cowardly from us to the crowd pressing threateningly round them.

A thin pale girl broke from the crowd. So she had found courage to do what I asked her!

"That's him," she said, pointing at Kraftstudt. "And him," she added, nodding her chin at Pfaff. "They started it all...."

A murmur came from the crowd. Voices were raised in anger. The people surged forward. Another moment and the criminals would have been torn limb from limb. But Deinis raised his hand.

"Friends, we're civilised people," he said. "We mustn't take justice into our own hands. The interests of humanity will be better served if we let the world know about their crimes. They must be brought to trial and we will all stand as witnesses. Within those walls heinous crimes have been committed. Taking advantage of the progress of science, those monsters were reducing men to slavery and exploiting them to the last spark of life."

"Bring the criminals to trial!" everybody shouted. "Bring 'em to trial!"

The crowd headed for town. The criminals were in a tight circle. Elsa Brinter, the thin girl, walked at my side. She clutched my hand as she spoke to me:

"I thought hard after our last conversation. Then I somehow felt strong and brave. And very angry for you and your friends and myself too."

"That's what always happens to those who hate their enemies and love their friends," I said.

Kraftstudt and his associates were handed over to the town authorities. The Burgomaster made along speech studded with biblical references. He ended by saying: "For crimes so subtle in their cruelty Herr Kraftstudt and his colleagues will be tried by the Federal Court of Justice."

Then they were taken away in police vans, and have not been heard of since. Nor have there been any reports in the press. But it has been rumoured that Kraftstudt and his colleagues entered government service and were entrusted with setting up a large computer centre for the Defence Ministry.

I always boil with indignation now when looking through a newspaper I find on the last page this perennial advertisement:

WANTED
for work at a large computer
centre
men aged 25-40 and having
knowledge of higher mathematics.
Write to Box***

SF compilation "DESTINATION: AMALTHEIA"

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